accordance with HRF–1–2008, (incorporated by reference; see §430.3), section 3.30 and sections 4.2 through 4.3.

In the case of freezers with automatic icemakers, the volume occupied by the automatic icemaker, including its ice storage bin, is to be included in the volume measurement.

6. Calculation of Derived Results From Test Measurements

6.1 Adjusted Total Volume. The adjusted total volume, VA, for freezers under test shall be defined as:

$VA = VT \times CF$

Where:

VA = adjusted total volume in cubic feet;
VT = total refrigerated volume in cubic feet; and
CF = dimensionless correction factor of 1.76.

6.2 Average Per-Cycle Energy Consumption

6.2.1 The average per-cycle energy consumption for a cycle type is expressed in kilowatt-hours per cycle to the nearest one hundredth (0.01) kilowatt-hour and shall depend on the compartment temperature attainable as shown below.

6.2.1.1 If the compartment temperature is always below 0.0 °F (−17.8 °C), the average per-cycle energy consumption shall be equivalent to:

$E = ET1 + IET$

Where:

E = total per-cycle energy consumption in kilowatt-hours per day;
ET is defined in 5.2.1;
The number 1 indicates the test period during which the highest compartment temperature is measured; and
IET, expressed in kilowatt-hours per cycle, equals 0.23 for a product with an automatic icemaker and otherwise equals 0 (zero).

6.2.1.2 If one of the compartment temperatures measured for a test period is greater than 0.0 °F (17.8 °C), the average per-cycle energy consumption shall be equivalent to:

$E = ET1 + ((ET2 - ET1) \times (0.0 - TF1)/(TF2 - TF1)) + IET$

Where:

E and IET are defined in 6.2.1.1 and ET is defined in 5.2.1;
TF = freezer compartment temperature determined according to 5.1.3 in degrees F;
The numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate; and
0.0 = standardized compartment temperature in degrees F.

6.2.2 Variable Anti-Sweat Heater Models. The standard cycle energy consumption of an electric freezer with a variable anti-sweat heater control (E_{std}), expressed in kilowatt-hours per day, shall be calculated equivalent to:

E_{std} = E + (Correction Factor) where E is determined by 6.2.1.1, or 6.2.1.2, whichever is appropriate, with the anti-sweat heater switch in the "off" position or, for a product without an anti-sweat heater switch, the anti-sweat heater in its lowest energy use state.

Correction Factor = (Anti-sweat Heater Power × System-loss Factor) × (24 hrs/1 day) × (1 kW/1000 W)

Where:

Anti-sweat Heater Power = 0.034 * (Heater Watts at 5%RH)
+ 0.211 * (Heater Watts at 15%RH)
+ 0.204 * (Heater Watts at 25%RH)
+ 0.166 * (Heater Watts at 35%RH)
+ 0.126 * (Heater Watts at 45%RH)
+ 0.119 * (Heater Watts at 55%RH)
+ 0.069 * (Heater Watts at 65%RH)
+ 0.047 * (Heater Watts at 75%RH)
+ 0.008 * (Heater Watts at 85%RH)
+ 0.015 * (Heater Watts at 95%RH)

Heater Watts at a specific relative humidity = the nominal watts used by all heaters at that specific relative humidity, 72 °F ambient (22.2 °C), and DOE reference freezer (FZ) average temperature of 0 °F (−17.8 °C).

System-loss Factor = 1.3

7. Test Procedure Waivers

To the extent that the procedures contained in this appendix do not provide a means for determining the energy consumption of a freezer, a manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product. Such instances could, for example, include situations where the test set-up for a particular freezer basic model is not clearly defined by the provisions of section 2. For details regarding the criteria and procedures for obtaining a waiver, please refer to 10 CFR 430.27.

[75 FR 78866, Dec. 16, 2010]

EFFECTIVE DATE NOTE: At 75 FR 78866, Dec. 16, 2010, Appendix B to Subpart B of Part 430 was added, effective Apr. 15, 2011.

APPENDIX B1 TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF FREEZERS

1. Definitions.

1.1 "HRF–1–1979" means the Association of Home Appliance Manufacturers standard for household refrigerators, combination refrigerators-freezers, and household freezers, also

approved as an American National Standard as a revision of ANSI B38.1–1970.

1.2 "Anti-sweat heater" means a device incorporated into the design of a freezer to prevent the accumulation of moisture on exterior surfaces of the cabinet under conditions of high ambient humidity.

1.3 "Cycle" means the period of 24 hours for which the energy use of a freezer is calculated as though the consumer-activated compartment temperature controls were preset so that the desired compartment temperatures were maintained.

1.4 "Cycle type" means the set of test conditions having the calculated effect of operating a freezer for a period of 24 hours with the consumer-activated controls other than the compartment temperature control set to establish various operating characteristics.

1.5 "Standard cycle" means the cycle type in which the anti-sweat heater switch, when provided, is set in the highest energy consuming position.

1.6 "Adjusted total volume" means the product of, (1) the freezer volume as defined in HRF–1–1979 in cubic feet, times (2) an adjustment factor.

1.7 "Automatic Defrost" means a system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during the operation of the automatic defrost system.

1.8 "Long-time Automatic Defrost" means an automatic defrost system where successive defrost cycles are separated by 14 hours or more of compressor-operating time.

1.9 "Stabilization Period" means the total period of time during which steady-state conditions are being attained or evaluated.

1.10 "Variable defrost control" means a long-time automatic defrost system (except the 14-hour defrost qualification does not apply) where successive defrost cycles are determined by an operating condition variable or variables other than solely compressor operating time. This includes any electrical or mechanical device. Demand defrost is a type of variable defrost control.

1.11 "Quick freeze" means an optional feature on freezers which is initiated manually and shut off manually. It bypasses the thermostat control and places the compressor in a steady-state operating condition until it is shut off.

2. Test Conditions.

2.1 Ambient temperature. The ambient temperature shall be 90.0±1.0 °F. (32.2±0.6 °C.) during the stabilization period and during the test period. The ambient temperature shall be 80±2 °F dry bulb and 67 °F wet bulb during the stabilization period and during the test period when the unit is tested in accordance with section 3.3.

2.2 Operational conditions. The freezer shall be installed and its operating conditions maintained in accordance with HRF–1–1979, section 7.2 through section 7.4.3.3, except that the vertical ambient gradient at locations 10 inches (25.4 cm) out from the centers of the two sides of the unit being tested is to be maintained during the test. Unless the area is obstructed by shields or baffles, the gradient is to be maintained from 2 inches (5.1 cm) above the floor or supporting platform to a height one foot (30.5 cm) above the unit under test. Defrost controls are to be operative and the anti-sweat heater switch is to be "on" during one test and "off" during a second test. The quick freeze option shall be switched off unless specified.

2.3 Steady State Condition. Steady state conditions exist if the temperature measurements taken at four minute intervals or less during a stabilization period are not changing at a rate greater than 0.042 °F. (0.023 °C.) per hour as determined by the applicable condition of A or B.

A—The average of the measurements during a two hour period if no cycling occurs or during a number of complete repetitive compressor cycles through a period of no less than two hours is compared to the average over an equivalent time period with three hours elapsed between the two measurement periods.

B—If A above cannot be used, the average of the measurements during a number of complete repetitive compressor cycles through a period of no less than two hours and including the last complete cycle prior to a defrost period, or if no cycling occurs, the average of the measurements during the last two hours prior to a defrost period; are compared to the same averaging period prior to the following defrost period.

3. Test Control Settings.

3.1 Model with no user operable temperature control. A test shall be performed during which the compartment temperature and energy use shall be measured. A second test shall be performed with the temperature control electrically short circuited to cause the compressor to run continuously. If the model has the quick freeze option, it is to be used to bypass the temperature control.

3.2 Model with user operable temperature control. Testing shall be performed in accordance with one of the following sections using the standardized temperature of 0.0 °F. (−17.8 °C.). Variable defrost control models shall achieve 0±2 °F during the steady-state conditions prior to the optional test with no door openings.

3.2.1 A first test shall be performed with all temperature controls set at their median position midway between their warmest and

coldest settings. Knob detents shall be mechanically defeated if necessary to attain a median setting. A second test shall be performed with all controls set at either their warmest or their coldest setting (not electrically or mechanically bypassed), whichever is appropriate, to attempt to achieve compartment temperatures measured during the two tests which bound (i.e., one is above and one is below) the standardized temperature. If the compartment temperatures measured during these two tests bound the standardized temperature, then these test results shall be used to determine energy consumption. If the compartment temperature measured with all controls set at their coldest setting is above the standardized temperature, a third test shall be performed with all controls set at their warmest setting and the result of this test shall be used with the result of the test performed with all controls set at their coldest setting to determine energy consumption. If the compartment temperature measured with all controls set at their warmest setting is below the standardized temperature; then the result of this test alone will be used to determine energy consumption.

3.2.2 Alternatively, a first test may be performed with all temperature controls set at their warmest setting. If the compartment temperature is below the standardized temperature, then the result of this test alone will be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with 3.2.1 above.

3.2.3 Alternatively, a first test may be performed with all temperature controls set at their coldest setting. If the compartment temperature is above the standardized temperature, a second test shall be performed with all controls set at their warmest setting and the results of these two tests shall be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with 3.2.1 above.

3.3 Variable defrost control optional test. After a steady-state condition is achieved, the door-opening sequence is initiated with an 18±2 second freezer door-opening occurring every eight hours to obtain three door-openings per 24-hour period. The first freezer door-opening shall occur at the initiation of the test period. The door(s) are to be opened 60 to 90°with an average velocity for the leading edge of the door of approximately two feet per second. Prior to the initiation of the door-opening sequence, the freezer defrost control mechanism may be re-initiated in order to minimize the test duration.

4. Test Period.

4.1 Test Period. Tests shall be performed by establishing the conditions set forth in Section 2 and using control settings as set forth in Section 3 above.

4.1.1 Nonautomatic Defrost. If the model being tested has no automatic defrost system, the test time period shall start after steady state conditions have been achieved, and be of not less than three hours' duration. During the test period the compressor motor shall complete two or more whole cycles (a compressor cycle is a complete "on" and a complete "off" period of the motor). If no "off" cycling will occur, as determined during the stabilization period, the test period shall be three hours. If incomplete cycling (less than two compressor cycles) occurs during a 24 hour period, the results of the 24 hour period shall be used.

4.1.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time period shall start after steady state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time automatic defrost system, the alternate provisions of 4.1.2.1 may be used. If the model being tested has a variable defrost control the provisions of 4.1.2.2. shall apply.

4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the test time period may consist of two parts. A first part would be the same as the test for a unit having no defrost provisions (section 4.1.1). The second part would start when a defrost period is initiated during a compressor "on" cycle and terminate at the second turn "on" of the compressor motor or after four hours, whichever comes first.

4.1.2.2 Variable defrost control. If the model being tested has a variable defrost control system, the test shall consist of three parts. Two parts shall be the same as the test for long-time automatic defrost in accordance with section 4.1.2.1 above. The third part is the optional test to determine the time between defrosts (5.2.1.3). The third part is used by manufacturers that choose not to accept the default value of F of 0.20, to calculate CT.

4.1.2.3 Variable defrost control optional test. After steady-state conditions with no door-openings are achieved in accordance with section 3.3 above, the test is continued using the above daily door-opening sequence until stabilized operation is achieved. Stabilization is defined as a minimum of three consecutive defrost cycles with times between defrost that will allow the calculation of a Mean Time Between Defrosts (MTBD1) that satisfies the statistical relationship of 90 percent confidence. The test is repeated on at least one more unit of the model and until the Mean Time Between Defrosts for the multiple unit test (MTBD2) satisfies the statistical relationship. If the time between defrosts is greater than 96 hours (compressor

"on" time) and this defrost period can be repeated on a second unit, the test may be terminated at 96 hours (CT) and the absolute time value used for MTBD for each unit.

5. Test Measurements.

5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figure 7–2 of HRF–1–1979 and shall be accurate to within ±0.5 °F. (0.3 °C.) of true value.

5.1.1 Measured Temperature. The measured temperature is to be the average of all sensor temperature readings taken at a particular time. Measurements shall be taken at regular intervals not to exceed four minutes.

5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken during a complete cycle or several complete cycles of the compressor motor (one compressor cycle is one complete motor "on" and one complete motor "off" period). For long-time automatic defrost models, compartment temperature shall be that measured in the first part of the test period specified in 4.1.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in 4.1.2.2.

5.1.2.1 The number of complete compressor motor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings rounded up to the next whole minute or a number of complete cycles over a time period exceeding one hour. One of the cycles shall be the last complete compressor motor cycles during the test period.

5.1.2.2 If no compressor motor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last thirty-two minutes of the test period.

5.1.2.3 If incomplete cycling occurs (less than one cycle) the compartment temperature shall be the average of all readings taken during the last three hours of the last complete "on" period.

5.2 Energy Measurements:

5.2.1 Per-day Energy Consumption. The energy consumption in kilowatt-hours per day for each test period shall be the energy expended during the test period as specified in section 4.1 adjusted to a 24 hour period.

The adjustment shall be determined as follows:

5.2.1.1 Nonautomatic and automatic defrost models. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET=(EP\times 1440\times K)/T$ where

ET=test cycle energy expended in kilowatt-hours per day,

EP=energy expended in kilowatt-hours during the test period.

T=length of time of the test period in minutes,

1440=conversion factor to adjust to a 24 hour period in minutes per day, and

K=correction factor of 0.7 for chest freezers and 0.85 for upright freezers to adjust for average household usage, dimensionless.

5.2.1.2 Long-time Automatic Defrost. If the two part test method is used, the energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET=(1440\times K\times EP1/T1) + ((EP2-(EP1\times T2/T1))\times K\times 12/CT)$

where

ET, 1440, and K are defined in 5.2.1.1

EP1=energy expended in kilowatt-hours during the first part of the test.

EP2=energy expended in kilowatt-hours during the second part of the test,

CT=Defrost timer run time in hours required to cause it to go through a complete cycle, to the nearest tenth hour per cycle,

12=conversion factor to adjust for a 50% run time of the compressor in hours per day, and

T1 and T2=length of time in minutes of the first and second test parts respectively.

5.2.1.3 Variable defrost control. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET=(1440\times EP1/T1) + (EP2 - (EP1\times T2/T1)\times (12/CT)$ where 1440 is defined in 5.2.1.1 and EP1, EP2, T1, T2 and 12 are defined in 5.2.1.2.

$CT=(CT_L\times CT_M)/(Fx\ (CT_M - CT_L) + CT_L)$

where:

CT_L=least or shortest time between defrost in tenths of an hour (greater than or equal to 6 hours but less than or equal to 12 hours, $6 \le {}_L \le 12$)

CT_M=maximum time between defrost cycles in tenths of an hour (greater than CT_L but not more than 96 hours, $CT_L \le CT_M \le 96$)

F=ratio of per day energy consumption in excess of the least energy and the maximum difference in per day energy consumption and is equal to

$F=(1/CT - 1/CT_M)/(1/CT_L - 1/CT_M) = (ET - ET_L)/(ET_M - ET_L)$ or 0.20 in lieu of testing to find CT

ET_L=least electrical energy consumed, in kilowatt hours

ET_M=maximum electrical energy consumed, in kilowatt hours

For demand defrost models with no values for CT_L and CT_M in the algorithm the default values of 12 and 84 shall be used, respectively.

5.2.1.4 Variable defrost control optional test. Perform the optional test for variable defrost control models to find CT.

CT=MTBD × 0.5

MTBD=mean time between defrost

$$MTBD = \frac{\sum X}{N}$$

X=time between defrost cycles

N=number of defrost cycles

5.3 Volume measurements. The total refrigerated volume, VT, shall be measured in accordance with HRF–1–1979, section 3.20 and section 5.1 through 5.3.

6. Calculation of Derived Results From Test Measurements.

6.1 Adjusted Total Volume. The adjusted total volume, VA, for freezers under test shall be defined as:

VA=VT× CF

where

VA=adjusted total volume in cubic feet,

VT=total refrigerated volume in cubic feet, and

CF=Correction factor of 1.73, dimensionless.

6.2 Average Per Cycle Energy Consumption:

6.2.1 The average per-cycle energy consumption for a cycle type is expressed in kilowatt-hours per cycle to the nearest one hundredth (0.01) kilowatt-hour and shall depend upon the compartment temperature attainable as shown below.

6.2.1.1 If the compartment temperature is always below 0.0 °F. (−17.8 °C.), the average per-cycle energy consumption shall be equivalent to:

E=ET1

where

E=Total per-cycle energy consumption in kilowatt-hours per day.

ET is defined in 5.2.1, and

Number 1 indicates the test period during which the highest compartment temperature is measured.

6.2.1.2 If one of the compartment temperatures measured for a test period is greater than 0.0 °F. (17.8 °C.), the average per-cycle energy consumption shall be equivalent to:

E=ET1+((ET2−ET1)×(0.0−TF1)/(TF2−TF1))

where

E is defined in 6.2.1.1

ET is defined in 5.2.1

TF=compartment temperature determined according to 5.1.2 in degrees F.

Numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate, and

0.0=Standardized compartment temperature in degrees F.

[47 FR 34528, Aug. 10, 1982; 48 FR 13013, Mar. 29, 1983, as amended at 54 FR 36241, Aug. 31, 1989; 54 FR 38788, Sept. 20, 1989]

EFFECTIVE DATE NOTE: At 75 FR 78871, Dec. 16, 2010, Appendix B1 to Subpart B of Part 430 was amended as follows, effective Jan. 18, 2011.

a. Adding an introductory paragraph after the appendix heading;

b. Revising section 1. Definitions;

c. In section 2. Test Conditions, by:

1. Revising sections 2.1 and 2.2;

2. Redesignating section 2.3 as 2.7;

3. Adding new sections 2.3 through 2.6;

d. In section 3. Test Control Settings, by:

1. Revising sections 3.1, 3.2, and 3.2.1;

2. Removing section 3.3;

e. Revising section 4, Test Period;

f. In section 5, Test Measurements, by:

1. Revising sections 5.1, 5.1.2, 5.1.2.1, 5.1.2.2, 5.1.2.3, 5.2.1.2, and 5.2.1.3;

2. Adding new section 5.1.3;

3. Removing section 5.2.1.4;

g. In section 6. Calculation of Derived Results From Test Measurements, by:

1. Revising section 6.2.1.2;

2. Adding a new section 6.2.2

h. Adding new section 7, Waivers.

For the convenience of the user, the added and revised text is set forth as follows:

APPENDIX B1 TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF FREEZERS

The provisions of Appendix B1 shall apply to all products manufactured prior to the effective date of any amended standards promulgated by DOE pursuant to Section 325(b)(4) of the Energy Policy and Conservation Act of 1975, as amended by the Energy Independence and Security Act of 2007 (to be codified at 42 U.S.C. 6295(b)(4)).

1. Definitions

Section 3, *Definitions*, of HRF–1–1979 (incorporated by reference; see §430.3) applies to this test procedure.

1.1 Adjusted total volume" means the product of, (1) the freezer volume as defined in HRF–1–1979 in cubic feet, times (2) an adjustment factor.

1.2 "Anti-sweat heater" means a device incorporated into the design of a freezer to prevent the accumulation of moisture on exterior or interior surfaces of the cabinet.

1.3 "Anti-sweat heater switch" means a user-controllable switch or user interface which modifies the activation or control of anti-sweat heaters.

1.4 "Automatic Defrost" means a system in which the defrost cycle is automatically

initiated and terminated, with resumption of normal refrigeration at the conclusion of defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during the operation of the automatic defrost system.

1.5 "Cycle" means the period of 24 hours for which the energy use of a freezer is calculated as though the consumer-activated compartment temperature controls were set to maintain the standardized temperature (see section 3.2).

1.6 "Cycle type" means the set of test conditions having the calculated effect of operating a freezer for a period of 24 hours with the consumer-activated controls other than the compartment temperature control set to establish various operating characteristics.

1.7 "HRF–1–1979" means the Association of Home Appliance Manufacturers standard for household refrigerators, combination refrigerator-freezers, and household freezers, also approved as an American National Standard as a revision of ANSI B 38.1–1970. Only sections of HRF–1–1979 (incorporated by reference; see §430.3) specifically referenced in this test procedure are part of this test procedure. In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over HRF–1–1979.

1.8 "Long-time Automatic Defrost" means an automatic defrost system where successive defrost cycles are separated by 14 hours or more of compressor-operating time.

1.9 "Quick freeze" means an optional feature on freezers that is initiated manually. It bypasses the thermostat control and operates continually until the feature is terminated either manually or automatically.

1.10 "Separate auxiliary compartment" means a freezer compartment other than the first freezer compartment of a freezer having more than one compartment. Access to a separate auxiliary compartment is through a separate exterior door or doors rather than through the door or doors of another compartment. Separate auxiliary freezer compartments may not be larger than the first freezer compartment.

1.11 "Special compartment" means any compartment without doors directly accessible from the exterior, and with separate temperature control that is not convertible from fresh food temperature range to freezer temperature range.

1.12 "Stabilization Period" means the total period of time during which steady-state conditions are being attained or evaluated.

1.13 "Standard cycle" means the cycle type in which the anti-sweat heater switch, when provided, is set in the highest energy consuming position.

1.14 "Variable defrost control" means an automatic defrost system in which successive defrost cycles are determined by an operating condition variable or variables other than solely compressor operating time. This includes any electrical or mechanical device performing this function. A control scheme that changes the defrost interval from a fixed length to an extended length (without any intermediate steps) is not considered a variable defrost control. A variable defrost control feature should predict the accumulation of frost on the evaporator and react accordingly. Therefore, the times between defrost should vary with different usage patterns and include a continuum of lengths of time between defrosts as inputs vary.

* * * * *

2. Test Conditions

2.1 Ambient Temperature. The ambient temperature shall be 90.0 ± 1.0 °F (32.2 ± 0.6 °C) during the stabilization period and the test period.

2.2 Operational Conditions. The freezer shall be installed and its operating conditions maintained in accordance with HRF–1–1979, (incorporated by reference; see §430.3), section 7.2 through section 7.4.3.3 (but excluding section 7.4.3.2), except that the vertical ambient gradient at locations 10 inches (25.4 cm) out from the centers of the two sides of the unit being tested is to be maintained during the test. Unless the area is obstructed by shields or baffles, the gradient is to be maintained from 2 inches (5.1 cm) above the floor or supporting platform to a height 1 foot (30.5 cm) above the unit under test. Defrost controls are to be operative. The quick freeze option shall be switched off except as specified in section 3.1. Additional clarifications are noted in sections 2.3 through 2.6.

2.3 Anti-Sweat Heaters. The anti-sweat heater switch is to be on during one test and off during a second test. In the case of an electric freezer equipped with variable anti-sweat heater control, the standard cycle energy use shall be the result of the calculation described in 6.2.2.

2.4 The cabinet and its refrigerating mechanism shall be assembled and set up in accordance with the printed consumer instructions supplied with the cabinet. Set-up of the freezer shall not deviate from these instructions, unless explicitly required or allowed by this test procedure. Specific required or allowed deviations from such set-up include the following:

(a) Connection of water lines and installation of water filters are not required;

(b) Clearance requirements from surfaces of the product shall be as specified in section 2.6 below;

(c) The electric power supply shall be as described in HRF–1–1979 (incorporated by reference; see §430.3) section 7.4.1;

(d) Temperature control settings for testing shall be as described in section 3 of this appendix. Settings for special compartments shall be as described in section 2.5 of this appendix;

(e) The product does not need to be anchored or otherwise secured to prevent tipping during energy testing; and

(f) All the product's chutes and throats required for the delivery of ice shall be free of packing, covers, or other blockages that may be fitted for shipping or when the icemaker is not in use.

For cases in which set-up is not clearly defined by this test procedure, manufacturers must submit a petition for a waiver (see section 7).

2.5 Special compartments shall be tested with controls set to provide the coldest temperature. This requirement for the coldest temperature does not apply to features or functions (such as quick freeze) that are initiated manually and terminated automatically within 168 hours.

2.6 The space between the back of the cabinet and a vertical surface (the test room wall or simulated wall) shall be the minimum distance in accordance with the manufacturer's instructions.

* * * * *

3. Test Control Settings

3.1 Model with No User Operable Temperature Control. A test shall be performed during which the compartment temperature and energy use shall be measured. A second test shall be performed with the temperature control electrically short circuited to cause the compressor to run continuously. If the model has the quick freeze option, this option must be used to bypass the temperature control.

3.2 Model with User Operable Temperature Control. Testing shall be performed in accordance with one of the following sections using the standardized temperature of 0.0 °F (−17.8 °C).

For the purposes of comparing compartment temperatures with standardized temperatures, as described in sections 3.2.1 through 3.2.3, the freezer compartment temperature shall be as specified in section 5.1.3.

3.2.1 A first test shall be performed with all temperature controls set at their median position midway between their warmest and coldest settings. For mechanical control systems, knob detents shall be mechanically defeated if necessary to attain a median setting. For electronic control systems, the test shall be performed with all compartment temperature controls set at the average of the coldest and warmest settings—if there is no setting equal to this average, the setting closest to the average shall be used. If there are two such settings equally close to the average, the higher of these temperature control settings shall be used. If the compartment temperature measured during the first test is higher than the standardized temperature, the second test shall be conducted with the controls set at the coldest settings. If the compartment temperature measured during the first test is lower than the standardized temperature, the second test shall be conducted with the controls set at the warmest settings. If the compartment temperatures measured during these two tests bound the standardized temperature, then these test results shall be used to determine energy consumption. If the compartment temperature measured with all controls set at their coldest settings is above the standardized temperature, a third test shall be performed with all controls set at their warmest settings and the result of this test shall be used with the result of the test performed with all controls set at their coldest settings to determine energy consumption. If the compartment temperature measured with all controls set at their warmest settings is below the standardized temperature, then the result of this test alone will be used to determine energy consumption.

* * * * *

4. Test Period

Tests shall be performed by establishing the conditions set forth in section 2 and using the control settings as set forth in section 3 of this appendix.

4.1 Nonautomatic Defrost. If the model being tested has no automatic defrost system, the test time period shall start after steady-state conditions have been achieved and be no less than 3 hours in duration. During the test period, the compressor motor shall complete two or more whole compressor cycles. A compressor cycle is a complete "on" and a complete "off" period of the motor. If no "off" cycling will occur, as determined during the stabilization period, the test period shall be 3 hours. If incomplete cycling occurs (less than two compressor cycles during a 24-hour period), the results of the 24-hour period shall be used.

4.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time period shall start after steady-state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time automatic defrost system, the alternate provisions of 4.2.1 may be used. If the model being tested has a variable defrost control, the provisions of 4.2.2 shall apply.

4.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the two-part test described in this section may be used. The first

part is the same as the test for a unit having no defrost provisions (section 4.1). The second part would start when a defrost is initiated when the compressor "on" cycle is terminated prior to start of the defrost heater and terminates at the second turn "on" of the compressor or 4 hours from the initiation of the defrost heater, whichever comes first.

4.2.2 Variable Defrost Control. If the model being tested has a variable defrost control system, the test shall consist of the same two parts as the test for long-time automatic defrost (section 4.2.1).

5. Test Measurements

5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figure 7.2 of HRF–1–1979 (incorporated by reference; see §430.3) and shall be accurate to within ± 0.5 °F (0.3 °C).

If the interior arrangements of the cabinet do not conform with those shown in Figure 7.2 of HRF–1–1979, the product may be tested by relocating the temperature sensors from the locations specified in the figures to avoid interference with hardware or components within the cabinet, in which case the specific locations used for the temperature sensors shall be noted in the test data records maintained by the manufacturer, and the certification report shall indicate that non-standard sensor locations were used.

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5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken during one or more complete compressor cycles. One compressor cycle is one complete motor "on" and one complete motor "off" period. For long-time automatic defrost models, compartment temperature shall be that measured in the first part of the test period specified in section 4.2.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.2.

5.1.2.1 The number of complete compressor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings rounded up to the next whole minute or a number of complete compressor cycles over a time period exceeding 1 hour. One of the compressor cycles shall be the last complete compressor cycle during the test period before start of the defrost control sequence for products with automatic defrost.

5.1.2.2 If no compressor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last 32 minutes of the test period.

5.1.2.3 If incomplete compressor cycling occurs (less than one compressor cycle), the compartment temperature shall be the average of all readings taken during the last 3 hours of the last complete compressor "on" period.

5.1.3 Freezer Compartment Temperature. The freezer compartment temperature shall be calculated as:

$$TF = \frac{\sum_{i=1}^{F}(TF_i) \times (VF_i)}{\sum_{i=1}^{F}(VF_i)}$$

Where:

F is the total number of applicable freezer compartments, which include the first freezer compartment and any number of separate auxiliary freezer compartments;

TF_i is the compartment temperature of freezer compartment "i" determined in accordance with section 5.1.2; and

VF_i is the volume of freezer compartment "i".

* * * * *

5.2.1.2 Long-time Automatic Defrost. If the two part test method is used, the energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET = (1440 \times K \times EP1/T1) + (EP2 - EP1 \times T2/T1)) \times K \times (12/CT)$

Where:

ET, 1440, and K are defined in section 5.2.1.1;

EP1 = energy expended in kilowatt-hours during the first part of the test;

EP2 = energy expended in kilowatt-hours during the second part of the test;

CT = defrost timer run time or compressor run time between defrosts in hours required to cause it to go through a complete cycle, rounded to the nearest tenth of an hour;

12 = conversion factor to adjust for a 50 percent run time of the compressor in hours per day; and

T1 and T2 = length of time in minutes of the first and second test parts respectively.

5.2.1.3 Variable Defrost Control. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET = (1440 \times K \times EP1/T1) + (EP2 - (EP1 \times T2/T1)) \times K \times (12/CT)$,

Where:

ET, K, and 1440 are defined in section 5.2.1.1 and EP1, EP2, T1, T2, and 12 are defined in section 5.2.1.2.

$CT = (CT_L \times CT_M)/(F \times (CT_M - CT_L) + CT_L)$

Where:

CT_L = least or shortest compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than or equal to 6 hours but less than or equal to 12 hours);

CT_M = maximum compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than CT_L but not more than 96 hours);

F = ratio of per day energy consumption in excess of the least energy and the maximum difference in per-day energy consumption and is equal to 0.20.

For variable defrost models with no values for CT_L and CT_M in the algorithm, the default values of 12 and 84 shall be used, respectively.

* * * * *

6. Calculation of Derived Results From Test Measurements

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6.2.1.2 If one of the compartment temperatures measured for a test period is greater than 0.0 °F (17.8 °C), the average per-cycle energy consumption shall be equivalent to:

$E = ET1 + ((ET2 - ET1) \times (0.0 - TF1)/(TF2 - TF1))$

Where:

E is defined in 6.2.1.1;

ET is defined in 5.2.1;

TF = freezer compartment temperature determined according to 5.1.3 in degrees F;

The numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate; and

0.0 = Standardized compartment temperature in degrees F.

* * * * *

6.2.2 Variable Anti-Sweat Heater Models. The standard cycle energy consumption of an electric freezer with a variable anti-sweat heater control (E_{std}), expressed in kilowatt-hours per day, shall be calculated equivalent to:

E_{std} = E + (Correction Factor) where E is determined by 6.2.1.1, or 6.2.1.2, whichever is appropriate, with the anti-sweat heater switch in the "off" position or, for a product without an anti-sweat heater switch, the anti-sweat heater in its lowest energy use state.

Correction Factor = (Anti-sweat Heater Power × System-loss Factor) × (24 hrs/1 day) × (1 kW/1000 W)

Where:

Anti-sweat Heater Power = 0.034 * (Heater Watts at 5%RH)
+ 0.211 * (Heater Watts at 15%RH)
+ 0.204 * (Heater Watts at 25%RH)
+ 0.166 * (Heater Watts at 35%RH)
+ 0.126 * (Heater Watts at 45%RH)
+ 0.119 * (Heater Watts at 55%RH)
+ 0.069 * (Heater Watts at 65%RH)
+ 0.047 * (Heater Watts at 75%RH)
+ 0.008 * (Heater Watts at 85%RH)
+ 0.015 * (Heater Watts at 95%RH)

Heater Watts at a specific relative humidity = the nominal watts used by all heaters at that specific relative humidity, 72 °F (22.2 °C) ambient, and DOE reference freezer (FZ) average temperature of 0 °F (−17.8 °C).

System-loss Factor = 1.3.

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7. Test Procedure Waivers

To the extent that the procedures contained in this appendix do not provide a means for determining the energy consumption of a freezer, a manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product. Such instances could, for example, include situations where the test set-up for a particular freezer basic model is not clearly defined by the provisions of section 2. For details regarding the criteria and procedures for obtaining a waiver, please refer to 10 CFR 430.27.

APPENDIX C TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF DISHWASHERS

The provisions of this Appendix C shall apply to products manufactured after September 29, 2003. The restriction on representations concerning energy use or efficiency in 42 U.S.C. 6293(c)(2) shall apply on February 25, 2004.

1. Definitions

1.1 *AHAM* means the Association of Home Appliance Manufacturers.

1.2 *Compact dishwasher* means a dishwasher that has a capacity of less than eight